

WHAT IS CLAIMED IS:

1. An infusion apparatus implantable in a human body, comprising:
 - a medication reservoir for storing a medication;
 - a carrier reservoir for storing a carrier, wherein the carrier reservoir is larger than the medication reservoir;
 - a mixing chamber in which the medication and carrier are thoroughly mixed, thus diluting the medication with the carrier;
 - a medication flow path fluidly connecting the medication reservoir to the mixing chamber;
 - a carrier flow path fluidly connecting the carrier reservoir to the mixing chamber;
 - a medication pump system for discharging the medication to the mixing chamber;
 - a carrier pump system for discharging the carrier to the mixing chamber; and
 - an outlet port fluidly connected to the mixing chamber for discharging a diluted medication/carrier mixture.

2. The implantable infusion apparatus of claim 1, further comprising:
 - a bolus port disposed between the mixing chamber and the outlet port.

3. The implantable infusion apparatus of claim 1, further comprising:
a medication flow restrictor disposed in the medication flow path to restrict a flow of the medication between the medication reservoir and the mixing chamber.
4. The implantable infusion apparatus of claim 1, further comprising:
a carrier flow restrictor disposed in the carrier flow path to restrict a flow of the carrier between the carrier reservoir and the mixing chamber.
5. The implantable infusion apparatus of claim 4, further comprising:
a medication flow restrictor disposed in the medication flow path to restrict a flow of the medication between the medication reservoir and the mixing chamber.
6. The implantable infusion apparatus of claim 5, wherein the medication flow restrictor is more restrictive than the carrier flow restrictor.
7. The implantable infusion apparatus of claim 5, wherein the medication flow restrictor is less restrictive than the carrier flow restrictor.
8. The implantable infusion apparatus of claim 1, wherein the medication flow path is more restrictive than the carrier flow path.

10. The implantable infusion apparatus of claim 1, wherein the medication pump system has a medication discharge rate and the carrier pump system has a carrier discharge rate, and the medication discharge rate is greater than the carrier discharge rate.

12. The implantable infusion apparatus of claim 1, wherein the medication pump system and the carrier pump system comprises a power cell selected from the group consisting of a two-phase fluid power cell associated with the medication and the carrier reservoirs, the fluid in the power cell vaporizing at physiological temperatures and a gas pressurized power cell charged with a propellant.

14. The implantable infusion apparatus of claim 1, wherein the mixing chamber is a microfluidic chip.

a medication flow path fluidly connecting the medication reservoir to the mixing chamber;

a carrier flow path fluidly connecting the carrier reservoir to the mixing chamber;

a medication pump system for discharging the medication into the mixing chamber;

a carrier pump system for discharging the carrier into the mixing chamber;

an electronically controlled medication flow selector disposed in the medication flow path for controlling a discharge rate of the medication to the mixing chamber; and

an outlet port fluidly connected to mixing chamber for discharging a diluted medication/carrier mixture.

20. The implantable infusion apparatus of claim 19, wherein the medication flow selector is one of a valve and a pump.

21. The implantable infusion apparatus of claim 19, wherein the medication flow selector further comprises a controller for altering the medication discharge rate.

22. The implantable infusion apparatus of claim 19, further comprising:
an electronically controlled carrier flow selector disposed in the carrier flow path for controlling a discharge rate of the carrier to the mixing chamber.

23. The implantable infusion apparatus of claim 22, wherein the carrier flow selector is one of a valve and a pump.

23. The implantable infusion apparatus of claim 22, wherein the carrier flow selector further comprises a controller for altering the carrier discharge rate.

24. The implantable infusion apparatus of claim 19, further comprising:
a bolus port disposed between the mixing chamber and the outlet port.

25. The implantable infusion apparatus of claim 19, further comprising:
a medication flow restrictor disposed in the medication flow path prior to the medication flow selector for restricting the flow of the medication between the medication reservoir and the mixing chamber.

26. The implantable infusion apparatus of claim 19, further comprising:
a carrier flow restrictor disposed in the carrier flow path to restrict the flow of the carrier between the carrier reservoir and the mixing chamber.

27. The implantable infusion apparatus of claim 25, further comprising:
a medication flow restrictor disposed in the medication flow path prior to the medication flow selector to restrict the flow of the medication between the medication reservoir and the medication flow selector.

28. The implantable infusion apparatus of claim 26, wherein the medication flow restrictor is more restrictive than the carrier flow restrictor.

29. The implantable infusion apparatus of claim 26, wherein the medication flow restrictor is less restrictive than the carrier flow restrictor.

30. The implantable infusion apparatus of claim 19, wherein the medication flow path is more restrictive than the carrier flow path.

31. The implantable infusion apparatus of claim 19, wherein the medication flow path is less restrictive than the carrier flow path.

32. The implantable infusion apparatus of claim 19, wherein the carrier pump system has a carrier discharge rate and the medication discharge rate is greater than the carrier discharge rate.

33. The implantable infusion apparatus of claim 19, wherein the carrier pump system has a carrier discharge rate and the medication discharge rate is less than the carrier discharge rate.

34. The implantable infusion apparatus of claim 19, wherein the medication pump system and the carrier pump system comprises a power cell selected from the group consisting of a two-phase fluid power cell associated with the medication and the carrier reservoirs, the fluid in the power cell vaporizing at physiological temperatures and a gas pressurized power cell charged with a propellant.

35. The implantable infusion apparatus of claim 19, wherein the medication pump system and the carrier pump system comprises a battery operated system.

36. The implantable infusion apparatus of claim 19, wherein the mixing chamber is a microfluidic chip.

37. The implantable infusion apparatus of claim 25, wherein the medication flow restrictor is a microfluidic chip.

38. The implantable infusion apparatus of claim 26, wherein the carrier flow restrictor is a microfluidic chip.

39. The implantable infusion apparatus of claim 19, further comprising a housing enclosing the implantable infusion apparatus wherein the housing is sized to be implantable in the human body.

40. The implantable infusion apparatus of claim 19, further comprising:

a medication access port to access the medication reservoir and covered with a medication compound septum; and

a carrier access port to access the carrier reservoir and covered with a carrier compound septum.

41. A method of infusing medication comprising:

storing a medication in a medication reservoir;

storing a carrier in a carrier reservoir, wherein the carrier reservoir is larger than the medication reservoir;

discharging the medication to a mixing chamber;

discharging the carrier to the mixing chamber;

mixing the medication with the carrier in the mixing chamber to dilute medication and form a medication/carrier mixture; and

discharging the diluted medication/carrier mixture.

42. The method of claim 41, further comprising:

introducing a bolus dosage into the diluted medication/carrier mixture prior to discharging the diluted medication/carrier mixture.

43. The method of claim 41, further comprising:

restricting the discharge of the medication.

49. A method of infusing medication comprising:
storing a medication in a medication reservoir;
storing a carrier in a carrier reservoir, wherein the carrier reservoir is larger than the medication reservoir;
controlling the discharge of the medication into a mixing chamber;
discharging the carrier into the mixing chamber;
mixing the medication with the carrier in the mixing chamber to dilute it to form a diluted medication/carrier mixture; and
discharging the diluted medication/carrier mixture.

50. The method of claim 49, further comprising:
introducing a bolus dosage into the diluted medication/carrier mixture prior to discharging the diluted medication/carrier mixture.

51. The method of claim 49, further comprising:
restricting the discharge of the medication.

52. The method of claim 49, further comprising:
restricting the discharge of the carrier.

53. The method of claim 49, further comprising:
restricting the discharge of the medication.
54. The method of claim 53, further comprising:
restricting the discharge of the medication more than the discharge of the
carrier.
55. The method of claim 53, further comprising:
restricting the discharge of the carrier more than the discharge of the
medication.
56. The method of claim 49, wherein the mixing step comprises:
contacting the medication with the carrier in the mixing chamber;
flowing a contacted medication/carrier mixture through a series of mixing
elements; and
delaying the discharging step until the medication is diluted to the proper
dosage.